Criminal History Systems: New Technology and New Directions

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ABSTRACT

Many forces are driving States to improve their current Criminal History and On-Line Criminal Justice Information Systems. The predominate factors compelling this movement are (1)the deterioration and cost of supporting older legacy systems, (2)current generation high performance, low cost hardware and system software, and (3)funding programs, such as the National Criminal History Improvement Program (NCHIP), which are targeted specifically at improving these important systems.

In early 1996, SAIC established an Internal Research and Development project devoted to Computerized Criminal History Systems (CCH). This project began with an assessment of current hardware, operating system, and relational database technology. Application software design and development approaches were then reviewed with a focus on object-oriented approaches, three tier client server architectures, and tools that enable the "right sizing" of systems. An operational prototype of a State CCH system was established based on the results of these investigations.

Keywords: Law Enforcement, Criminal History, Hot Files, NCHIP

SUMMARY

This paper will present a summary of an investigation that was conducted regarding the use of new technology in evaluating and implementing a current generation Computerized Criminal History (CCH) system. It will first establish a frame of reference by defining the CCH system domain that was the subject of the investigation. Next, it will present the factors that are causing these systems to change. Finally, the paper will summarize the results of this investigation with an emphasis on the new technology and new directions that were adopted as an outcome of the research. Highlights of this analysis include the use of Object-Oriented techniques, and the deployment of three tiered client server solutions using relational database systems and a transaction processing software architecture.

CRIMINAL HISTORY SYSTEMS - THE SUBJECT OF OUR INVESTIGATION

Criminal history systems are present and are used in every jurisdiction and by a wide variety of information consumers within each jurisdiction. Jurisdictions include City, County, Regional, State, and Federal systems. Consumers of information within each of these jurisdictions include Law Enforcement, Prosecution, Courts, Jails, Probation and Parole. The predominate Criminal Justice Information System (CJIS) domains are:

- Municipal Criminal Justice Information
- State Computerized Criminal History and Criminal Justice Information
- State Bureau of Crime Statistics
- Prosecution and Court
- Correction, Probation and Parole
- Federal

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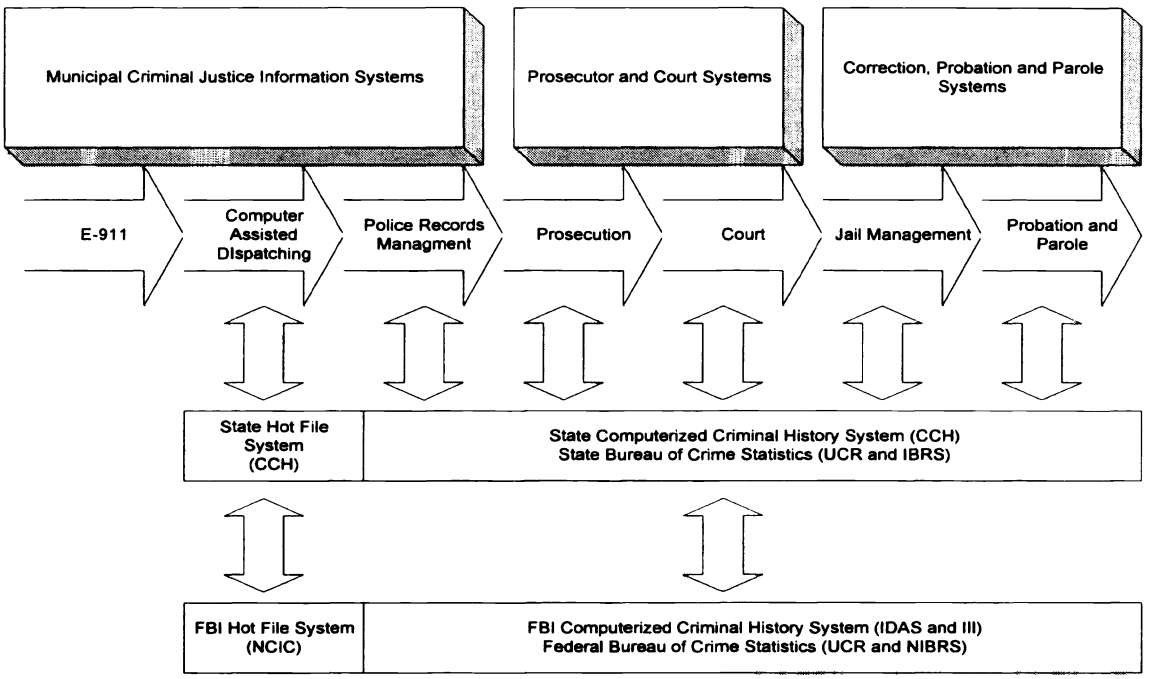
These relationship of these systems is depicted in the following diagram:


Municipal Criminal Justice Information Systems
Prosecutor and Court Systems
Correction, Probation and Parole Systems
E-911
Computer Assisted Dispatching
Police Records Managment
Prosecution
Court
Jail Management
Probation and Parole
State Hot File System (CCH)
State Computerized Criminal History System (CCH)
State Bureau of Crime Statistics (UCR and IBRS)
FBI Hot File System (NCIC)
FBI Computerized Criminal History System (IDAS and III)
Federal Bureau of Crime Statistics (UCR and NIBRS)

Depending on the size and maturity of the domain, these systems may be manual, automated, or a mixture of both. Generally, within each of these broad domain categories there will be many supporting systems.

The principal support systems within each domain are:

Municipal Criminal Justice Information Systems

- E-911
- Computer Assisted Dispatch
- Incident and Crime Reporting
- Investigation Support
- Arrest and Booking
- Crime Analysis and Statistics
- Citations, Traffic Accident

State Computerized Criminal History

- Public Safety Agency Message Switching
- Gateway to Federal CJIS, State DMV, NLETS, and other Systems
- Hot Files - Wanted Persons, Stolen Vehicles, Property
- Criminal History Information
- Sex Offender and Handgun Registration, Orders of Protection

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State Bureau of Crime Statistics

- Uniform Crime Reporting (UCR)
- Incident Based Reporting (IBR)
- Special Investigations

Prosecution and Court

- Criminal and Civil Case Management
- Traffic Court Management
- Court Calendar and Jury Selection
- Warrants Processing

Correction, Probation and Parole

- Inmate Receiving, Discharge, and Property
- Medical and Visitor Log
- Parole and Probation Reports

Federal

- National Crime Information System (NCIC) - Hot Files
- Interstate Identification Index (III) - Criminal History Record Index
- Identification Division Automated Services (IDAS) - Criminal History Records
- Uniform Crime Reporting (UCR and NIBRS)

The subject of this paper and the focus of its investigation and analysis was on the State Computerized Criminal History (CCH) Repository and its related hot files and other On-Line Criminal Justice Information Systems.

CRIMINAL HISTORY SYSTEMS - WHY ARE THEY CHANGING?

Many forces are driving States to improve their current Criminal History and On-Line Criminal Justice Information Systems. Some of the prevalent ones are presented below:

National Task Force Report 1990

- High Incidence of Criminal Recidivism
- System Must Account for Recidivism
- Accurate and Complete Criminal History Needed by Law Enforcement, Prosecutors, and Sentencing Officials
- Current Records are Incomplete, Missing, or Posted Late

National Criminal History Improvement Program - 1993

- Brady Handgun Violence Prevention Act
- National Child Protection Act
- National Instant Criminal Background Check System (NICS)
- Background Checks for Child, Elder, and Disabled Care
- Felon Tracking

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Violent Crime Control and Law Enforcement Act - 1994

- Sex Offender Registration
- Domestic Abusers
- Three Strikes
- Death Penalty
- Technical Automation

Existing, Older State CCH and On-Line CJIS Systems

- Cost of Software Maintenance
- Cost of Hardware and Computing Infrastructure Maintenance
- Cost to Improve Existing Systems
- Ability to Maintain or Improve Existing Systems
- Organization Memory Loss
- Year 2000 Issues

NEW TECHNOLOGY AND NEW DIRECTIONS

In early 1996, SAIC established its Computerized Criminal History System (CCH) Internal Research and Development project. This project began with an assessment of current hardware, operating system, and relational database technology. Application software design and development approaches were reviewed with a focus on object-oriented approaches, three tier client server architectures, and tools that enable the "right sizing" of systems. An operational prototype of a CCH system was established based on the results of these investigations.

Object Oriented Approach

An object oriented approach to system requirements analysis, design, and implementation offers many advantages. Some of the most concrete benefits are:

- Effective representation of "real world" concepts
- Practical translation of object definitions into a relational database model
- Current generation procedural software languages
- Software code reuse and improved maintainability

An Object-Oriented analysis of a CCH System resulted in the following:

- Each individual maintained in the CCH system has some involvement with the criminal justice system.
- Most individuals begin their relationship with the CCH system upon their arrest. The individual is charged and "booked" with one or more criminal violations.
- Upon entering the Judicial system, the Arrest becomes a Court Case and the Arrest Charges become Court Counts. Arrest charges may be added, dropped or altered as determined by the prosecuting official.
- Depending on the outcome of the court, the individual may become involved with a Custody or Supervisory agency. The subject may be incarcerated in a jail, placed on probation, paroled, etc.

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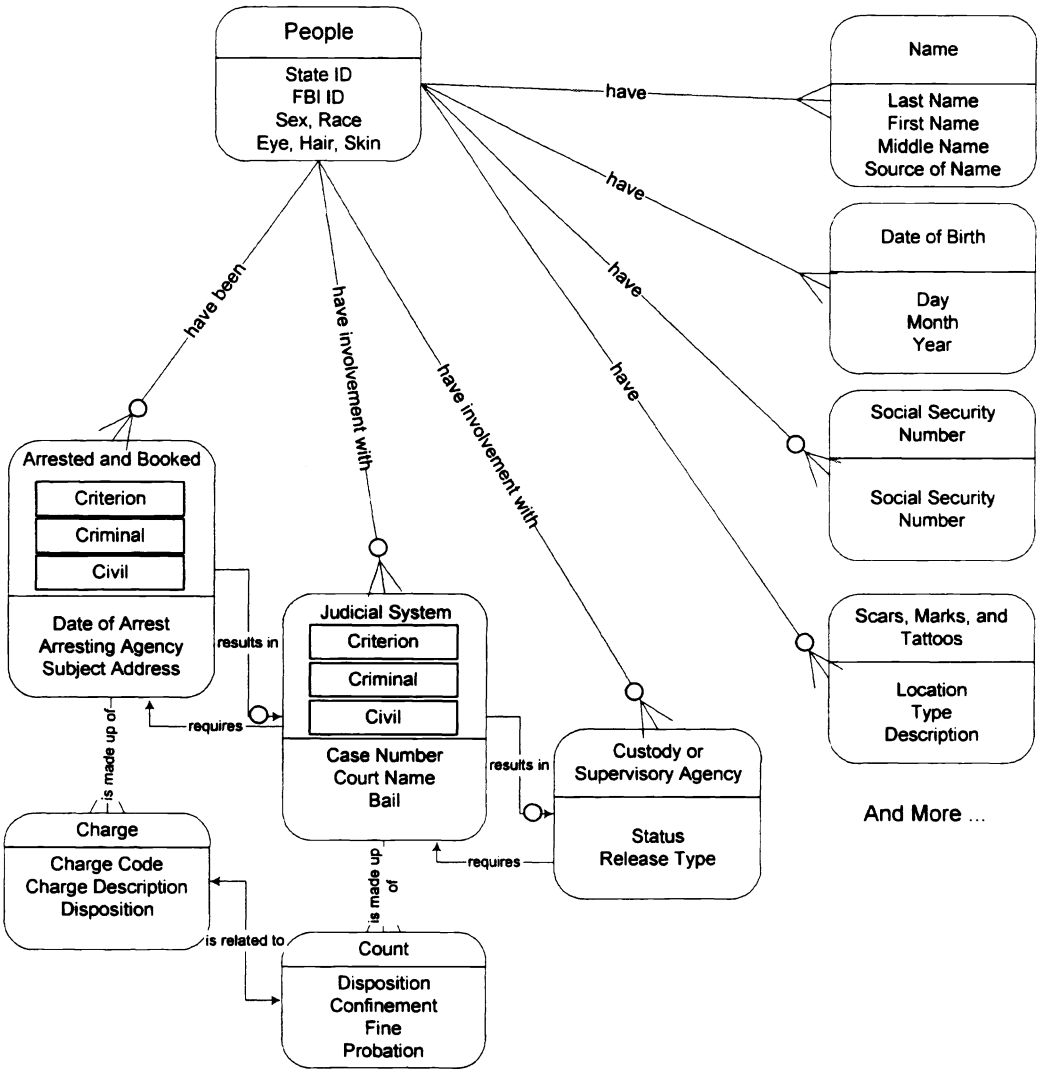
This analysis results in the following entity relationship diagram:



Object oriented analysis and representation of the objects and their properties easily translates to a physical implementation using a Relational Database Management System (RDBMS).

Relational Database Management System

The following diagram depicts an example of how the entity relationship regarding individuals and their attributes might be implemented using a relational database system. As depicted, each individual can be associated with one or more Name Aliases, Scars, Marks, or Tattoos, Driver License Numbers, other numbers, and even multiple Social Security Numbers, Dates of Birth, and Places of Birth. This relationship is established by using a unique State identification number (StateID) that is assigned to each positively identified individual.

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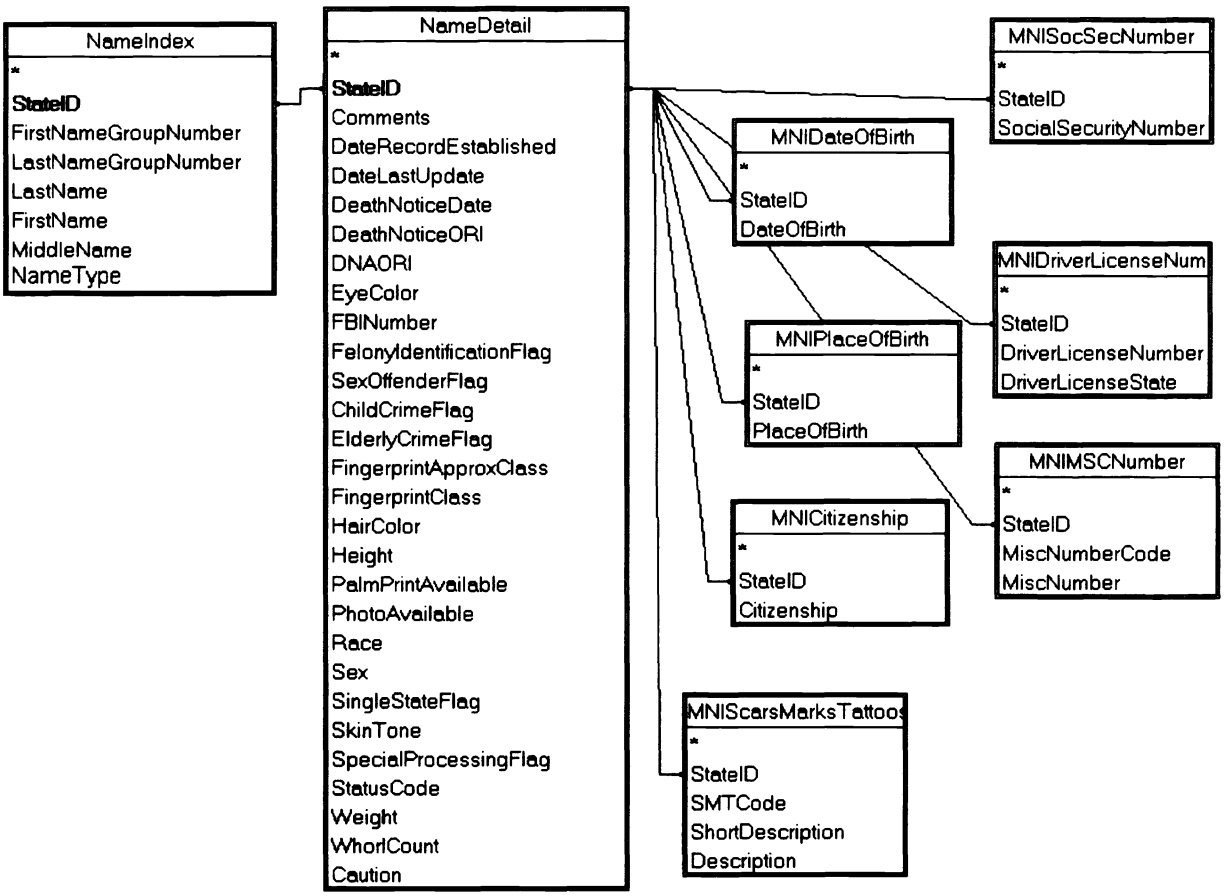

Defining the RDBMS physical implementation is a critical first step towards implementing a three tier client server application. The resulting database table layouts, data element rules, and referential relationships provide the foundation from which the CCH application software will be based. A successful RDBMS design will be vendor independent and allow any RDBMS software to be used as the data storage tier of the three tier client server architecture.

Three Tier Client Server

A three tier client server system can be deployed in a variety of configuration. Some vendors define the most basic client server system as a client terminal attached to a mainframe computer running an application program that stores data in a VSAM file. However, the first recognized generation of client server systems used Personal Computers (PC) as client workstations running application software on the PC which used a server computer for disk storage. A fully deployed three tier system would utilize a workstation for graphics and display services, an application server computer running transaction processing software, and a database server computer running a RDBMS package.

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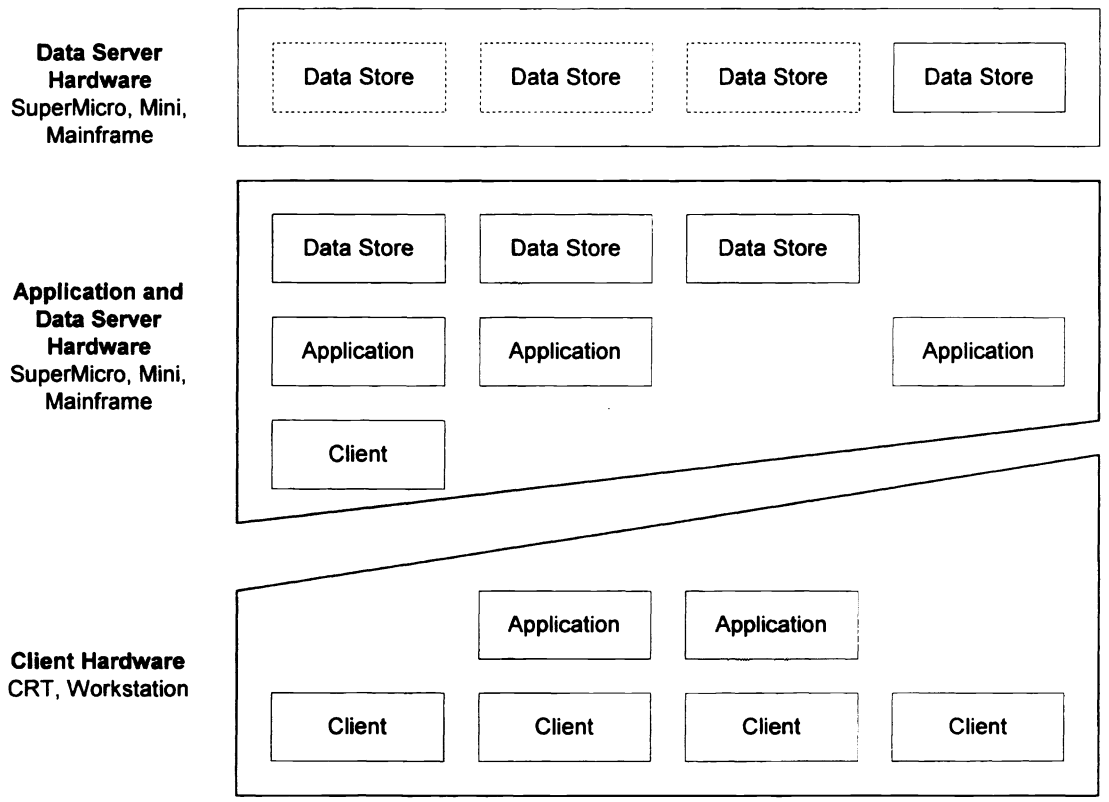
The following figure represents the most common configurations options of client server systems. Since the Data Store tier can be optionally dispersed, it is represented with a dotted line when it is optional.



Although all three tiers could be deployed on a single hardware platform, the existing user environment and other requirements of CCH systems require that the client tier must be deployed autonomous from the application and database server tiers.

Regardless of the deployment method selected, the following describes the attributes, environment, and requirements of each tier in a typical CCH system:

Client Tier

- Dumb Terminals for command line entry and simple protected field forms
- Personal Computers running custom software applications that emulate the functions provided by Dumb Terminals that are often obsolete
- Computer Assisted Dispatch (CAD) and Records Management Systems (RMS): A variety of data and inquiry entry programs and products that provide transactions in the format and syntax supported by the State CCH system
- Personal Computers running custom software applications in Microsoft Access, Visual Basic, "C/C++", Borland Delphi, and other 3/4GL environments

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Application Server Tier

- Message parsing, Syntax verification, Operator security
- Command or Transaction processing
- Procedural software language used to execute business logic (Application Server)
- RDBMS independent
- Application Server software modules organized by function
    - Candidate Scoring
    - RAP Sheet Generation
    - Hot File Inquiry
    - Data Entry

Database Tier

- Relational SQL database manager: SQL Server, Oracle, Informix, etc.
- Application Server software interface
- Database secures data
- Database provides referential integrity using Rules, Stored Procedures, Triggers, etc.
- Variety of options for database administration software applications
- Simplified interface to existing systems, court, custody, etc.
- Database replication

Transaction Processing Software Architecture

The transaction architecture employed by a CCH system must allow dissimilar systems to be integrated with the CCH system. The CCH system must be client indifferent. Using a standard interchange format, Municipal Police Records, Court, Jail, Computer Assisted Dispatch, remote inquiry workstation software, and other related systems must be able to interface to the CCH system.

In some instances, it may be desirable to modify or extended the capability of the attached system in order to exchange information with the CCH. In other cases, it may be desirable to modify the CCH system to act as an information gateway to these systems. This transaction-oriented approach must allow a variety of existing systems and assets to be used so that wholesale changes to existing data processing infrastructure should not be required.

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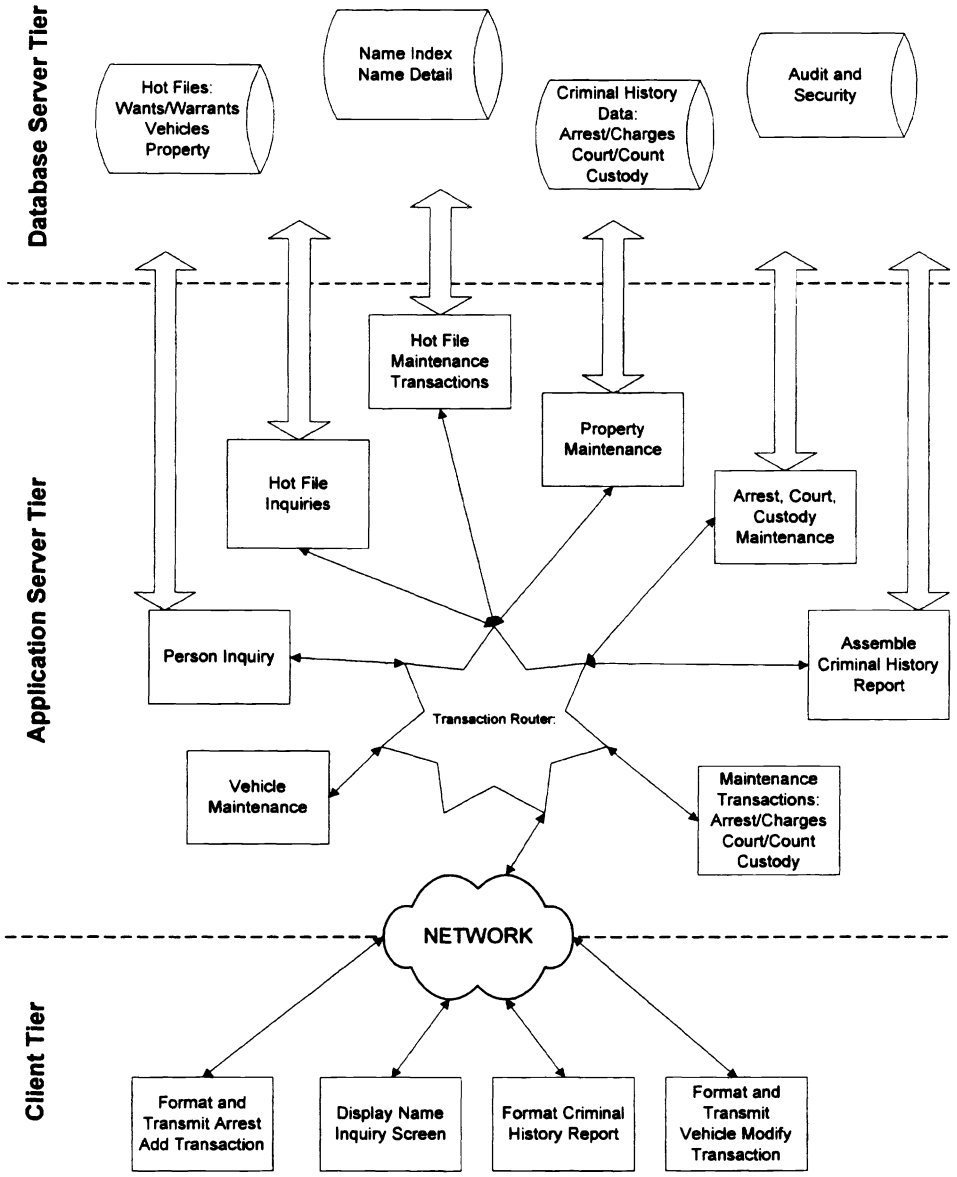
The following diagram depicts the transaction processing software architecture as implemented as a three tier solution:



Current Hardware, Operating Systems, And Relational Database Technology

The advances of hardware technology over the past several years has resulted in the ability to provide mainframe computer performance in small, departmental computers. For example, Symmetrical Processing Intel Pentium Pro computers, and the DEC Alpha line of Servers, offer incredible CPU performance, memory capacity, high speed system and I/O bus performance and a variety of advanced mass storage options such as Redundant Arrays of Inexpensive Disk (RAID) Storage.

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The State CCH system that currently occupies a large, raised floor, computer room, can now reside in a closet. In an audited TPC-C benchmark (accepted by TPC on December 20, 1995), a Microsoft NT Server and SQL Server combination executing on a Compaq Proliant 4500 5/133 performed 2454.97 transactions per minute, supporting 2500 concurrent users.

The Microsoft NT/SQL Server combination also provides high performance on DEC AlphaServer 2100 models. On December 4, 1995 DEC and Microsoft published a TPC-C benchmark of 3,194 transactions per minute using Microsoft SQL Server 6.5, Windows NT Server 3.51, and a DEC AlphaServer 2100 5/300 with three CPUs. This result set a new world record for database price/performance ($196 per tpmC). It was the highest transaction rate ever achieved on any open systems platform costing less than $1 million, outperforming a Tandem Himalaya K10000-16 with 16 CPUs and costing $3.5 million. The Microsoft/DEC system supported 3000 end-to-end users.

Operational Prototype

Under the CCH Internal Research And Development (IRAD) project, SAIC evaluated a variety of open systems technology approaches. An Open Systems approach means many things to many people. To the SAIC team, the following were used as principal drivers to define an open system:

- Multiple hardware deployment platforms
- Variety of software development tools
- Ability to leverage typical in-house expertise and skills
- Reduces cost of maintenance
- Ability to interface with variety of legacy, third party or custom software

Based on this criteria, SAIC selected the following components for development of its operational prototype:

Microsoft Windows/NT Server Operating System

Microsoft intends NT Server to be its flagship business operating system, replacing the many variants of UNIX, VMS, and other server operating systems. NT was designed to be a fully portable operating system with no ties to any specific hardware. It was developed on NEC MIPS-based workstations to ensure that any ties to the x86 instruction set were broken. It has now been ported to the Intel x86, DEC Alpha, PowerPC and PA RISC architectures.

Microsoft SQL Server Relational Database System

Microsoft SQL Server and Windows NT are highly integrated and provide all the functions needed to implement a transaction based system. Microsoft SQL Server incorporates an advanced new parallel database design, Symmetric Server Architecture, designed explicitly for Windows NT Server. This makes extensive use of native operating system threads to efficiently process tasks in parallel. SQL Server handles very large numbers of concurrent users with minimal system overhead.

Microsoft Visual C++

Microsoft Visual C++ provides current generation, real-world tools to help developers take advantage of the power of object-oriented approaches and code reuse. The C/C++ language is one of the most widely used and accepted software development environments in use today. This, combined with the

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development environment offered by one of the largest commercial software tool providers (Microsoft) ensures that the proposed environment will not be a "dead end" tool set.

This single vendor solution provides the highest degree of integration and "life of the line" available today. Few vendors today can offer a completely integrated platform that includes the operating system, relational database, software development workbench, procedural languages, source code control, data communication (SNA, TCP/IP), and more. Microsoft products offer an extremely effective integrated solution package that are designed to work together.

Using these tools, SAIC developed an operational prototype system. This system employs a three tier client server architecture that is completely client indifferent. Several test tools were developed in order to emulate a client environment. They operate on their own workstation computers under Microsoft Windows, Microsoft Windows 95, and Microsoft Windows NT Workstation environments. They communicate with the application server software via their network connection.

The application server component of the three tier architecture is written in Microsoft Visual C++ and operates under the NT Server operating system. It currently receives transactions from clients via a TCP/IP connection to the network. However, a variety of other supported data communication methods are also available and would be sufficient. It has been tested and operates on the Intel Pentium, Pentium Pro and DEC Alpha processors running the NT Server operating system.

The Microsoft SQL Server database is used as the third tier of this three tier architecture. It has co-existed on the same server computer as the application server software and has also been deployed on a separate database server computer. It has been tested and operates on the Intel Pentium, Pentium Pro and DEC Alpha processors running the NT Server operating system.

The application software developed conducts a criminal history check using the industry standard Query History (QH) transaction. The name provided, along with a variety of optional biometric parameters are evaluated against a test database of 10,000 subjects. A subject searching and scoring algorithm retrieves candidates and returns an ordered list to the requester.

The application software also supports the industry standard Query Report (QR) transaction. This transaction returns a comprehensive criminal history report (RAP Sheet) regarding the subject in the transmission and presentation format recommended by the SEARCH group.

SAIC's IRAD project is continuing and will add new transaction types, increased business logic complexity, and a larger test database. A variety of system load and testing tools are also being developed in order to assist with plans to deploy the application server and database server components of this system under the DEC AlphaServer 4100.

ACKNOWLEDGMENTS

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